#21/Appeal Br.
2-26-04

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of

Yukio NAKAJIMA

Appln. No.: 09/269,972

Confirmation No.: 1844

Filed: April 8, 1999

Docket No: Q53854

Group Art Unit: 2123

Examiner: Eduardo Garcia-OTERO

For: TIRE DESIGN METHOD, OPTIMIZATION ANALYZING APPARATUS, AND STORAGE MEDIUM HAVING STORED OPTIMIZATION ANALYZING PROGRAM

APPELLANTS' BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In accordance with the provisions of 37 C.F.R. § 1.192, Appellant submits the following:

I. REAL PARTY IN INTEREST

The real party in interest is Bridgestone Corporation by virtue of an assignment executed by Yukio Nakajima (Appellant, hereafter), on March 24, 1999 and recorded in the Patent and Trademark Office on April 8, 1999 at Reel 9926, Frame 0135.

II. RELATED APPEALS AND INTERFERENCES

To the best of the knowledge and belief of Appellant, the Assignee and the undersigned, there are no other appeals or interferences before the Board of Appeals and Interferences ("the Board") that will directly affect or be affected by the Board's decision in the present Appeal.

III. STATUS OF CLAIMS

Claims 1-19 are pending and are the subject of this appeal.

IV. STATUS OF AMENDMENTS

No amendments have been submitted after the final rejection of the claims in the May 14, 2003 Office Action.

V. SUMMARY OF THE INVENTION

The Appellant's invention relates to a tire design method, an optimization analyzing apparatus, and a storage medium incorporating instructions for performing tire design[1]. The invention is particularly useful in designing a tire by means of non-linear prediction, such as used by a neural network[2]. Use of non-linear prediction allows design of a tire to its optimum design for certain performance requirements rather than relying on conventional techniques, such as design by mathematical algorithms that, by their nature, only meet target values, rather than an optimum design.[3] The method of the invention, which provides a good summary of the invention in general, includes:

determining a conversion system in which a non-linear correspondence between design

[1] See specification at page 1, first paragraph.

[2] See specification at page 26, last paragraph.

[3] Id. at page 3, second paragraph.

parameters of a tire, which represent any one of a cross-sectional configuration of the tire including an internal structure and a structure of the tire, and performances of the tire is established;

determining an objective function which expresses said performances of the tire and setting a constraint condition which constrains an allowable range of at least one of said performances of the tire and manufacturing conditions of the tire; and

determining a design parameter of the tire, which gives an optimum value of an objective function, based on said objective function and said constraint condition by using the conversion system determined in said step (a) to design the tire based on the design parameter of the tire.[4]

The non-linear correspondence feature that distinguishes the present invention from the cited art can be realized, for example, as an optimization apparatus 30 that includes a non-linear calculation unit 32 of a conversion system comprising a neural network, and is used to obtain, based on data input from an experimental data unit 40, a conversion system in which the shape, structure, pattern, and manufacturing condition of a tire, and performances thereof are made to correlate with each other.[5]

The non-linear calculation unit 32 has a conversion function constructed by a conceptual neural network and can include, in one embodiment, a learning function that learns the conversion function. The conversion function is used to provide a correlation between the

[4] See claim 1.

[5] See specification at page 28, and Figure 3.

design parameters of the tire and the tire's performance.[6] The non-linear calculation unit 32 includes an input layer including neurons corresponding to the number of design parameters to be considered in the design of the tire, and an output layer with neurons corresponding to the number of tire performances to be predicted.[7]

VI. ISSUES

1. Whether claims 1-7, 9-13, and 15-19 are anticipated by Kamegawa et al. (U.S. Patent No. 5,710,718). 2. Whether claims 8 and 14 are unpatentable over Kamegawa et al. in view of Tang (U.S. Patent No. 6,061,673).

VII. GROUPING OF CLAIMS

Claims 1, 2, 4, 5, 9, 10, 11, 12, and 15-17 stand or fall together. Claims 8 and 14 stand or fall together. Claims 3, 6, and 18 stand or fall together. Claims 7, 13, and 19 stand or fall together.

VIII. ARGUMENTS

I. The claims are novel:

Claims 1-7, 9-13 and 15-19 stand rejected due to alleged anticipation under §102(e) over Kamegawa. Appellant respectfully submits that Kamegawa fails to disclose all of the claimed combinations of features, as required for an anticipation rejection.

[6] See specification at page 30, last paragraph.

[7] See specification at page 31, last paragraph continued to page 32.

First, Kamegawa discloses an iterative process of achieving an objective function, based on design variables, which have converged to an estimated value. A plurality of basic models are determined for the tire, each model having an objective function, design variable, constraint and fitness function. Alternative values are repeatedly searched for in the entire solution space, to cover *all* available alternative values, until a required performance level is achieved. Thus, a pool of solutions is generated. As a result, the calculations are iteratively performed on the entire solution space. Appellant respectfully submits that genetic algorithms of this kind require tremendous amounts of experimental and computational time, which is believed to be a disadvantage of the Kamegawa approach.

In contrast, the claimed invention uses neural networks that permit 'learning' in order to achieve a required performance level. This claimed scheme permits probabilistic matching so as to recognize and adapt to changing inputs, so that it is not necessary to iteratively operate on the *entire* solution space, as is done for Kamegawa. The difference in the approaches includes the difference between determining the best possible solution that can be achieved, versus determining how well adverse conditions can be compensated for while exploiting good conditions.

Because a non-linear relationship between performance of the tire and design parameter changes can occur in the claimed invention, the relationship between input data is learned through non-linear prediction (e.g., a neural network-based conversion system). More specifically, the neural network used by the invention performs prediction, and predicts to a

higher degree of accuracy than a related art linear transformation multi-variable analysis. The claimed conversion system (i.e., a correspondence between the design parameters of the tire and the performances thereof) is determined in advance.

Appellant respectfully submits that Kamegawa fails to disclose a conversion system in which a non-linear correspondence between design parameters of a tire and performances of the tire is established, as recited in independent claims 1, 10, and 15.

The Examiner has asserted that Kamegawa discloses both linear and non-linear objective functions, but acknowledges that Kamegawa does not explicitly disclose non-linear objective functions (see paragraph 18 of the May 14, 2003 Office Action, and paragraph 7 of the November 3, 2003 Advisory Action). To overcome this acknowledged explicit deficiency, the Examiner asserts that Kamegawa *implies* a non-linear objective function. Specifically, in the November 3, 2003 Advisory Action at paragraph 7, the Examiner states that Kawagawa's "objective function" at Figure 2 should be interpreted broadly as disclosing both linear and non-linear objective functions. The Examiner maintains that Kamegawa's "sensitivity" enables non-linear objective functions, and implicitly discloses non-linear objective functions (again, see paragraph 7 of the November 3, 2003 Advisory Action).

However, Appellant still maintains that the Examiner has not provided supporting evidence (either explicit or implicit) *from the art of record* to substantiate this characterization. Appellant submits that one of ordinary skill in the art at the time of invention would interpret Kamegawa as limited to a linear objective function, and has not found any disclosure that the

objective function of Kamegawa is also directed to non-linear objective functions. Without disclosure of the aforementioned claimed features in Kamegawa, it is believed that such a conclusory statement is merely speculative, and does not meet the requirements of 35 U.S.C. § 102. Further, the Examiner's conclusory statement in the Advisory Action is likely as a result of the teachings of the present specification.

The Examiner also asserts at paragraph 18 of the May 14, 2003 Office Action (and repeats this assertion in the Advisory Action) that Kamegawa uses a technique that would be useful if and when the objective function was non-linear. As discussed above, Appellant maintains that Kamegawa does not disclose a non-linear objective function. Thus, Appellant respectfully submits that it is not relevant whether the technique of Kamegawa would be hypothetically useful if applied to a non-linear objective function.

Additionally, the Examiner asserts at paragraphs 18 and 20 of the May 14, 2003 Office Action that Kamegawa's use of sensitivities to predict the maximum of the objective function implies (though does not require) that the objective function is non-linear. In response, Appellant respectfully submits that the Examiner has not explained how the 'sensitivity' is predictive, nor why it necessarily implies that the objective function is non-linear. The Examiner, in the Advisory Action at paragraph 7, only asserts that the May 14, 2003 Office Action goes into great detail in this matter - citing again the same paragraph 18 of the May 14, 2003 Office Action. Appellant also submits that the discussion associated with sensitivity is not relevant to the issue of whether Kamegawa discloses all of the claimed combinations of features.

The Examiner asserts that the 'sensitivity' for each design variable is repeatedly calculated, and would not have been calculated as such if the objective function was linear. However, Appellant respectfully submits that Kamegawa does not disclose the non-linearity of the objective function as the reason for repeating the sensitivity calculations. Instead, Kamegawa repeats calculations to implement a down-selection process from a plurality of basic models until a subset achieves a predetermined number. This iterative process is not disclosed in Kamegawa as being predictive and non-linear.

At paragraph 19 of the May 14, 2003 Office Action as repeated at paragraph 7 of the November 3, 2003 Advisory Action, the Examiner states that simpler predictive functions could be used if Kamegawa was limited to linear functions. However, Appellant respectfully submits that the Examiner has not provided an adequate basis for this hypothetical statement, which appears speculative at best, and perhaps based on Appellant's own disclosure. As discussed above, the Examiner has not adequately established that Kamegawa discloses non-linear objective functions. Further, it is submitted that Kamegawa does not disclose predictive functions, but functions that appear to only be determinative. Also, the Examiner does not explain the relevance of the simpler predictive functions as a motivating alternative disclosed in Kamegawa.

Thus, Appellant respectfully submits that Kamegawa does not disclose *a conversion system in which a non-linear correspondence between parameters of a tire and performance of*

the tire is established, as recited in independent claim 1, and similarly in claims 10 and 15, per the requirements of 35 U.S.C. §102.

Appellant respectfully submits that the dependent claims are allowable for at least the same reasons as the independent claims. Additionally, with respect to dependent claims 3, 6, and 18, as they are grouped above, the claimed invention relies upon predicted and calculated values in obtaining the optimum value of the objective function. This is done by using the conversion system constructed with a multi-layered feed forward type neural network, which permits probabilistic matching. Appellant respectfully submits that Kamegawa does not disclose a probabilistic conversion system or predictive functionality for similar reasons above, as recited in claims 3, 6 and 18.

Appellant also respectfully submits that Kamegawa fails to disclose the adaptive function recited in claims 7, 13 and 19. In Kamegawa, the use of the term 'mutate' refers to a change in the design variable, and *not* to the claimed adaptive function..

III. The claims would not have been obvious:

Claims 8 and 14, which stand or fall together, stand rejected due to alleged obviousness under §103(a) over Kamegawa in view of Tang.[8] Appellant respectfully submits that the proposed combination of Kamegawa and Tang is improper because the references cannot be properly combined, and further, even if they were properly combinable, the prior art cited by the Examiner either alone or in combination, still fails to disclose or suggest the features recited in claims 8 and 14.

The prior art fails to disclose a neural network conversion system that has learned to convert the design parameters of the performances thereof, as recited in claims 8 and 14. Also, Appellant respectfully submits that the Examiner's proposed combination of Kamegawa with Tang is improper. Neither of the references provides any motivation to be combined with the other, as proposed by the Examiner. Furthermore, notwithstanding the Examiner's assertions regarding the motivation to combine Kamegawa and Tang as stated in paragraph 10 of the November 3, 2003 Advisory Action, Appellant still maintains that the approach presented by Kamegawa teach away from the claimed invention.

For example, but not by way of limitation, the claimed invention implements feed forward neural networks, whereby the system learns through a predictive process so as to convert the design parameters of the performances thereof, as recited in claims 8 and 14. In contrast,

[8] In s 22 and 23 of the Office Action, the Examiner appears to be stating 35 U.S.C. §103 rejections.

Kamegawa imposes a selection process upon a plurality of basic models for subsequently determining, through iterative calculations, an objective function to achieve a predetermined performance (see column 6, line 31-4). These schemes are believed to be entirely different and incompatible with one another. The Examiner has not provided any substantive rebuttal of this argument, only that it is unpersuasive.[9]

Accordingly, Appellant respectfully submits that there is no motivation to combine the references in the absence of the specification supporting the presently claimed invention. As a result, Appellant respectfully submits that the presently claimed invention is the only possible basis for the Examiner's motivation. Appellant respectfully submits that it would be impermissible hindsight reconstruction to use the specification supporting the claimed invention as a motivation for combining the references. Further, it seems that the Examiner's arguments regarding the "implicit" non-linear objective functions being disclosed in Kamegawa also are as a result of hindsight. Therefore, Appellant submits that claims 1-19 are allowable.

The present Brief on Appeal is being filed in triplicate. Unless a check is submitted herewith for the fee required under 37 C.F.R. §1.192(a) and 1.17(c), please charge said fee to Deposit Account No. 19-4880.

[9] See paragraph 10 of the November 3, 2003 Advisory Action.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

35,603

Ronald L. Kimble
Registration No. 44,186

SUGHRUE MION, PLLC
Telephone: (202) 293-7060
Facsimile: (202) 293-7860

WASHINGTON OFFICE
23373
CUSTOMER NUMBER

Date: February 12, 2004

APPENDIX

CLAIMS 1-19 ON APPEAL:

1. A tire design method comprising the steps of:

(a) determining a conversion system in which a non-linear correspondence between design parameters of a tire, which represent any one of a cross-sectional configuration of the tire including an internal structure and a structure of the tire, and performances of the tire is established;

(b) determining an objective function which expresses said performances of the tire and setting a constraint condition which constrains an allowable range of at least one of said performances of the tire and manufacturing conditions of the tire; and

(c) determining a design parameter of the tire, which gives an optimum value of an objective function, based on said objective function and said constraint condition by using the conversion system determined in said step (a) to design the tire based on the design parameter of the tire.

2. A tire design method according to claim 1, wherein said step (c) comprises the steps of:

defining the design parameter of the tire as a design variable;

obtaining a value of the design variable, which gives the optimum value of the objective function, by using the conversion system determined in said step (a) while considering the constraint condition; and

designing the tire based on the design variable which gives the optimum value of the objective function.

3. A tire design method according to claim 2, wherein said step (c) comprises:

predicting an amount of change in the design variable which gives the optimum value of the objective function while considering the constraint condition based on a sensitivity of the objective function which is a ratio of an amount of change in the objective function to a unit amount of change in the design variable and a sensitivity of the constraint condition which is a ratio of an amount of change in the constraint condition to a unit amount of change in the design variable;

calculating a value of the objective function when the design variable is changed to correspond to a predicted amount and a value of the constraint condition when the design variable is changed to correspond to a predicted amount; and

based on the predicted and calculated values, obtaining a value of the design variable, which gives the optimum value of the objective function, by using the conversion system determined in said step (a) while considering the constraint condition.

4. A tire design method according to claim 1, wherein said step (c) comprises the steps of:

(d) selecting, as a design variable, one of the design parameters of the tire included in the conversion system determined in said step (a);

(e) changing a value of the design variable selected in the conversion system determined in said step (a) until the optimum value of the objective function is given by using the conversion system determined in said step (a) while considering the constraint condition; and

(f) designing the tire based on the design parameter of the tire obtained by the design variable which gives the optimum value of the objective function.

5. A tire design method according to claim 4, wherein said step (b) comprises the step of determining a constraint condition which constrains an allowable range of at least one of tire performances other than said determined objective function and the design parameters of the tire.

6. A tire design method according to claim 4, wherein said step (e) comprises:

predicting an amount of change in the design variable which gives the optimum value of the objective function while considering the constraint condition based on a sensitivity of the objective function which is a ratio of an amount of change in the objective function to a unit amount of change in the design variable and a sensitivity of the constraint condition which is a ratio of an amount of change in the constraint condition to a unit amount of change in the design variable;

calculating a value of the objective function when the design variable is changed to correspond to a predicted amount and a value of the constraint condition when the design variable is changed to correspond to a predicted amount; and

based on the predicted and calculated values, changing a value of the design variable to be selected until the optimum value of the objective function is given by using the conversion system determined in said step (a) while considering the constraint condition.

7. A tire design method according to claim 1, wherein said step (c) comprises the steps of:

defining the design parameters of the tire in the conversion system determined in said step (a) as base models to determine a group for selection comprising a plurality of base models;

determining said objective function, a design variable, a constraint condition and an adaptive function which can be evaluated from the objective function for each base model of the

group for selection;

selecting two base models from the groups for selection;

effecting at least one of producing new base models by intersecting the design variables of the two base models at a predetermined probability with each other and producing new base models by modifying in part the design variables of at least one of the two base models;

obtaining an objective function, a constraint condition, and an adaptive function of the base models using the conversion system determined in said step (a) by changing the design variable;

storing the base models whose design variables have been changed and base models whose design variables have not been changed;

repeating the storing step until the number of the stored base models reaches a predetermined number;

determining whether a new group comprising the stored base models of the predetermined number satisfies a predetermined convergence condition;

wherein if not, the above steps are repeated until with the new group defined as the group for selection the group for selection defined satisfies the predetermined convergence condition; and

if the predetermined convergence condition is satisfied, designing a tire based on the design parameters of the tire obtained by the design variable, which gives the optimum value of the objective function, among the predetermined number of the stored base models by using the conversion system determined in said step (a) while considering the constraint condition.

8. A tire design method according to claim 1, wherein in said step (a), said conversion system is constructed with data in a multi-layered feed forward type neural network which has learned so as to convert the design parameters of the tire to performances thereof.

9. A tire which is formed according to design parameters designed by a tire design method according to claim 1.

10. An optimization analyzing apparatus comprising:

conversion system calculating means for obtaining a non-linear corresponding relation between design parameters of a tire and performances of the tire;

input means for inputting an objective function and a constraint condition as optimization s by determining the objective function which expresses the performances of the tire and also by determining the constraint condition which constrains an allowable range of at least one of the performances of the tire and manufacturing conditions of the tire; and

optimization calculation means for obtaining a design parameter of the tire which gives an optimum value of the objective function based on the optimization s inputted by said input means using said conversion system calculation means.

11. An optimization analyzing apparatus according to claim 10, wherein said conversion system calculation means is provided to obtain a non-linear corresponding relation between, on the one hand, the design parameters of the tire and a condition to be applied to the tire, and on the other hand, the performances of the tire.

12. An optimization analyzing apparatus according to claim 10, wherein said optimization calculation means comprises:

selection means which selects one of the design parameters of the tire included in said

conversion system calculation means as a design variable;

changing means for changing a value of the design variable selected from said conversion system calculation means until the optimum value of the objective function is given, while considering the constraint condition;

optimum value calculation means for calculating a value of the design variable until the optimum value of the objective function is given by using said conversion system calculation means; and

design means for designing a tire based on the design parameter obtained by the design variable which gives the optimum value of the objective function.

13. An optimization analyzing apparatus according to claim 10, wherein said optimization calculation means comprises the steps of:

defining the design parameters of the tire in the corresponding relation determined in said conversion system calculation means as base models to determine a group for selection composed of a plurality of base models;

determining said objective function, a design variable, a constraint condition, and an adaptive function which can be evaluated from the objective function for each base model in the group for selection;

selecting two base models from the group for selection;

effecting at least one of producing new base models by intersecting the design variables of the selected two base models at a predetermined probability with each other and producing new base models by modifying in part the design variables of at least one of the two base models;

obtaining an objective function, a constraint condition, and an adaptive function of the base models which have been produced using said conversion system calculation means by changing a design variable;

storing the base model whose design variables have been changed and a base model whose design variables have not been changed;

repeating the storing step until the number of the stored base models reaches a predetermined number;

determining whether a new group comprising stored base models of the predetermined number satisfy a predetermined convergence condition;

wherein if not, the new group is defined as the group for selection and the above steps are repeated until the group for selection defined satisfies the predetermined convergence condition; and

if the predetermined convergence condition is satisfied, designing a tire based on a design parameter of the tire obtained by the design variable, which gives the optimum value of the objective function, among the predetermined number of the stored base models by using said conversion system calculation means while considering the constraint condition.

14. An optimization analyzing apparatus according to claim 10, wherein said conversion system calculation means is a multi-layered feed forward type neural network which has learned so as to convert the design parameters of the tire to the performances thereof.

15. A storage medium having a stored optimization analyzing program for design of a tire executed by a computer, wherein the optimization analyzing program is provided to:

determine a non-linear corresponding relation between design parameters of a tire and

performances of the tire;

determine an objective function which expresses the performances of the tire and determine a constraint condition which constrains an allowable range of at least one of the performances of the tire and manufacturing conditions of the tire; and

obtain a design parameter of the tire, which gives an optimum value of the objective function, based on the determined corresponding relation, the objective function, and the constraint condition to design a tire based on the design parameter of the tire.

16. A storage medium having a stored optimization analyzing program for design of a tire according to claim 15, wherein the design of a tire based on the design parameters of the tire comprises:

selecting, as a design variable, one of the design parameters of the tire included in the determined corresponding relation based on the determined corresponding relation, the objective function, and the constraint condition;

changing a value of the design variable selected from the determined corresponding relation until the optimum value of the objective function is given while considering the constraint condition; and

designing the tire based on the design parameter of the tire obtained by the design variable which gives the optimum value of the objective function.

17. A storage medium having a stored optimization analyzing program for design of a tire according to claim 16, wherein the constraint condition constrains an allowable range of at least one of the performances of the tire other than the determined objective function and the design parameters of the tire.

18. A storage medium having a stored optimization analyzing program for design of a tire according to claim 16, wherein the change of the design variable is effected by:

predicting an amount of change in the design variable which gives the optimum value of the objective function while considering the constraint condition based on a sensitivity of the objective function which is a ratio of an amount of change in the objective function to a unit amount of change in the design variable and a sensitivity of the constraint condition which is a ratio of an amount of change in the constraint condition to a unit amount of change in the design variable;

calculating a value of the objective function when the design variable is changed to correspond to a predicted amount and a value of the constraint condition when the design variable is changed to correspond to a predicted amount; and

changing a value of the design variable to be selected based on the predicted and calculated values until the optimum value of the objective function is given while considering the constraint condition.

19. A storage medium having a stored optimization analyzing program for design of a tire according to claim 16, wherein the design of a tire based on the design parameter of the tire comprises:

defining the design parameters of the tire in the determined corresponding relation as base models to determine a group for selection composed of a plurality of base models;

determine said objective function, a design variable, a constraint condition, and an adaptive function which can be evaluated from the objective function for each base model in the group for selection;

selecting two base models from the groups for selection;

effecting at least one of producing new base models by intersecting the design variables of the selected two base models at a predetermined probability with each other, and producing new base models by modifying in part the design variables of at least one of the two base models;

obtaining an objective function, a constraint condition, and an adaptive function of the base model using said conversion system calculation means by changing design variables;

storing the base models whose design variables have been changed and a base model whose design variables have not been changed;

repeating the storing step until the number of the stored base models reaches a predetermined number;

determining whether a new group comprising the stored base models of the predetermined number satisfies a predetermined convergence condition;

wherein if not, the new group is defined as the group for selection until the group for selection defined satisfies the predetermined convergence condition; and

if the predetermined convergence condition is satisfied, designing a tire based on the design parameter of the tire obtained by the design variable, which gives the optimum value of the objective function, among the predetermined number of the stored base models by using the corresponding relation while considering the constraint condition.